RHIC regime and some features

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A. Fedotov et al.

BROOKHAVEN
NATIONAL LABORATORY

"Scaling-2" was done with lower electron density than needed for RHIC, in order to use just 100K particles in simulations for a fast exploration of some parameters. Dependence on plasma density was checked close to RHIC numbers and even above – relatively linear dependence for relevant to RHIC parameters.

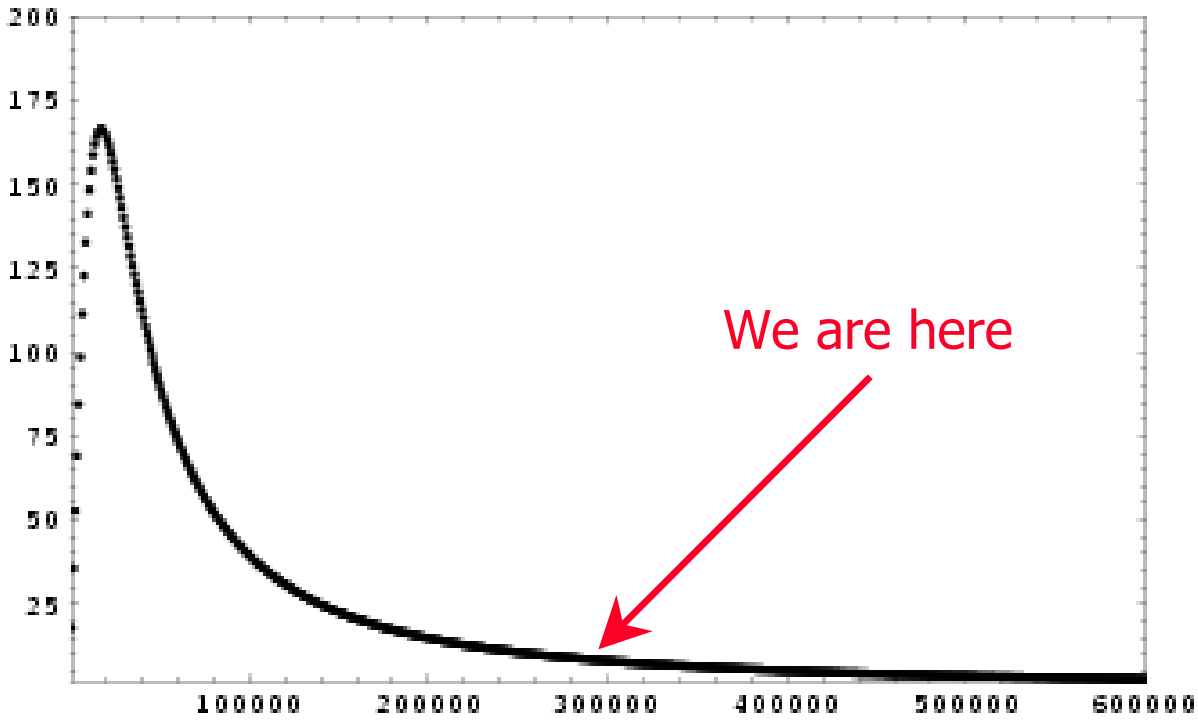
RHIC regime was reproduced with an appropriate scaling of ρ_{max}, ρ_{min} and r_L to have ratios between impact parameters similar to RHIC.

For RHIC, at rms ion velocities we have $\rho_{max}/r_L=3.5$

RHIC parameters

	Vorpal – "scaled-2"	RHIC
Vion_parallel [m/s]	$2*10^5$	$3*10^5$
Vion_transverse [m/s]	$2*10^5$	$6*10^5$
Zion	5*79	79
Ve_parallel [m/s]	$1*10^3$	$9*10^4$
Ve_transverse [m/s]	$4*10^6$	$9*10^6$
σ_x [m]	0.0002	0.0015
σ_z [m]	0.00025	0.05
n_e [m-3]	$6.35*10^{14}$	$2.7*10^{15}$
ω_{pe} [rad/s]	$1.4*10^9$	$2.9*10^9$

Friction force for RHIC parameters



Vion [m/s]

How much magnetic field is too low?

Cooling log is very small: $\mathrm{Log}[\rho_{max}/r_L]=1.3$

Applicability of all friction force formulas which we are using becomes questionable.

The immediate question: "Is B=1T enough?"

and

"If not, how much magnetic field to we need?"

Magnetic field dependence for RHIC regime

1. Tested dependence on magnetic field: Is 1T field enough?

   For 1T we are in "good magnetization" regime. Further increase of magnetic field improves magnetization – only Logarithmic dependence on magnetic field was observed, as expected:

$\Delta\_e\_t=4*10\text{^}6$:		dV_vorpal	dV_vp
$\rho_{max}/r_L=4$	B=1T	-1.5	-1.44
	B=2T	-2.0	-2.3

2. Dependence on magnetic field B=1 - > 4T for $\Delta\_e\_t=1*10\text{^}6$

   Log dependence on magnetic field was observed – as expected for very good magnetization

For RHIC one gets ρ_{max}/r_L=3.5 with transverse electron temperature of 400eV.

If T_{e_t} is increased from 400eV to 1500eV we can keep ratio of

ρ_{max}/r_L in the range 3 - 5 by increasing magnetic field strength from

B=1 -> 3T – present solenoid design will allow this range of magnetic field.

Δe_t -> ε_t – so linear increase in emittance can be compensated by linear increase of magnetic field B.

What are we afraid of? (apart from question of accuracy of Log formulas)

Bad magnetization –
so that "magnetized" cooling
force formula is no longer "friendly"

Summary

1. Present RHIC parameters seems to be in a good magnetization regime.
2. Magnetic field can be adjusted if transverse temperature of electron beam is increased (for various reasons).
3. Despite the fact that Cooling Log is very small – there seems to be a good agreement with empiric VP formula for this regime.

Other studies which were attempted:

- Study of "bad-magnetization" regime
- Maximum of the cooling force